Positive Displacement Flowmeters

Operational Manual

For Models
Model 241, 242

240 Helical Series

Positive Displacement Flow Meters

© Copyright 2015

Table of Contents

Before You Install ..... page 3
Meter General Description ..... page 3
Transmitter General Description ..... page 4
Meter Specifications ..... page 5
Do and Don'ts ..... page 5
Transmitter Specifications - Analog ..... page 6
Transmitter Specifications - Frequency (Pulse) ..... page 7
Installation ..... page 8
Piping Diagrams ..... page 9
ANSI FlangeANSI Flange Stud Torque ..... page 9
Operation ..... page 10
Troubleshooting ..... page 13
241 Helical Flow Meter ..... page 14
242 Helical Flow Meter
Contact for Repairs & Calibration Services
Limited Warranty ..... page 15

Custom Instructions for Hazardous Locations/Explosion Proof Housing:
http://www.maxmachinery.com/content/explosion-proof-installation-instructions

DO NOT ATTEMPT TO INSTALL OR START FLOW METER WITHOUT READING THIS ENTIRE MANUAL

Max Machinery, Inc. (MMI) reserves the right to make changes to the product in this Instruction Manual to improve performance, reliability, or manufacturability. Consequently, contact MMI for the latest available specifications and performance data. Although every effort has been made to ensure accuracy of the information contained in this Instruction Manual, MMI assumes no responsibility for inadvertent errors.

Before You Install

Thank you for choosing to install a Max Machinery precision flow meter. To ensure the best experience please take a moment to read through this manual prior to installation.

When you purchased this meter a flow engineer helped determine many of the factors that will be reviewed on the following pages. You may find it useful to fill out the form below and keep it in your files for reference.

When you are ready to do the installation there will be a few tools you will need:

Meter Installation:

- The meter and transmitter
- A signal cable (available from factory)
- The display or signal processing device
- Indicator Manual
- Calibration Certificate
- Bypass plumbing supplies

Many Max meters are installed and operate for decades, so having the following information in your records may prove useful. We have provided this outline as a starting point.

Process Temperatures _____ Fluid Viscosity_____

Operating Range _____ Line Pressure _____

Max Sales # or PO # _____ Installation Date _____

Meter Model # _____ Meter Serial #_____

Transmitter Model # _____ Transmitter Serial #_____

Notes: _____

_____

_____

Meter General Description

The Max 240 Series Flow Meters are positive displacement helical rotor type units capable of precise measurements over a wide range of flow rates and fluid viscosities.

The two sizes of this series (241 and 242) will measure flows from 0.1 L/min to 500 L/min. Material viscosities between 3 and 1,000,000 centipoise may be accommodated.

In a helical rotor type flow meter, a precise amount of the fluid being measured is trapped between the rotors as they turn. This motion is used to turn a gear coupled to a magnet. An external transmitter senses the motion of the magnet and converts this signal into a voltage, pulse or 4-20 mA current flow rate output. For some transmitter models, the magnet is eliminated and the motion of the gear itself is sensed.

The Max Series 240 Meters are of simple and rugged construction. They can be expected to perform superbly if treated within the confines of the design envelope. For this reason, it is important to read this manual and understand the operational requirements and limits of the meter.

Our Technical Service staff will be happy to answer any questions that this manual does not cover.

Transmitter General Description

Max transmitters are designed to work with the entire family of Max Flow Meters to provide extremely precise flow measurement in a cost effective package. Different options of industrial housings or IP66 rated explosion proof enclosures, combined with a choice of one-part and two-part, high temperature designs with remote electronics cover a wide range of application environments – from the laboratory to harsh industrial processes.

This latest generation of transmitters use modern sensor technology coupled with advanced signal processing to deliver high levels of performance and reliability. Hall sensors are used to detect the position of a driven magnet inside a Max Flow Meter. Changes in position are tracked by a microprocessor, which generates an output proportional to the flow rate. Advanced signal processing provides both fine angular resolution (0.36 degrees rotation) and rapid response (output updated every one millisecond).

Max transmitters are typically mated to a mechanical flow meter, configured, and calibrated at the factory as a set. This ensures accuracy and allows quick setup in the field. For field installations where the transmitter has not been set up with a meter at the factory, an optional serial interface kit may be purchased to give full access to configuration options and parameters.

Transmitter Features

High resolution measurement –

Analog Output: Configured output ranges to any value within ± 10 Vdc or ± 20 mA.
Frequency Output: Configured output resolution of 1 to 1000 pulses per revolution.
Linearization of up to 16 points to fully describe the flow meter's output curve and achieve the highest system linearity over the meter's entire operating range.

Compensation Algorithm – Compensates for variations in Hall sensor and flow meter characteristics to provide a stable, undamped output that accurately represents the instantaneous flow rate. This feature is factory set when the meter and transmitter are mated together. If the transmitter is changed, the compensation can be performed via a button on the circuit board.

Anti-Dither Buffer - Masks the false output that may occur at very low flow rates in the presence of vibration or hydraulic noise. If the meter reverses direction the output signal will be interrupted for a user selected portion of a meter rotation. Reverse flow exceeding the buffer setting will result in an output proportional to reverse flow rate. The buffer quantity can be set from 1% to 100% of a revolution.

Ex Proof Housing

Model 295
Analog/ Frequency

Model 289

Meter Specifications

Model	241	242
[1] **Maximum flow rate,**		
Gal/min	50	132
Liters/min	189	500
Maximum pressure, bar (psi)		
Standard NPT	35, (500)	35, (500)
600 lb ANSI RF flanges	105 (1500)	105 (1500)
1500 lb ANSI RF flanges	---	245 (3500)
2500 lb ANSI RF flanges	245 (3500)	---
Pressure drop, bar (PSI)		
Operating maximum	10 (150)	7 (100)
Absolute maximum	21 (300)	15 (200)
100% flow, 3 CPS	1 (14)	0.7 (10)
[2] **Maximum temperature**	Up to 265° C (500° F)	
[3] **Recommended filtration**	150 micron	
Displacement, L/Rev	0.062	0.182
Weight, Kg (Lb)	13.6 (30)	18.2 (40)
[4] **Typical K-Factor, (pulses/liter)**		
295 Transmitter	15000	5000
289-700 Transmitter	403	219
Port size		
NPT	1.5"	2.5"
ANSI RF flanges	1.5" (DN40)	2.5" (DN65)

Notes:

[1] For viscosities of 3 CPS or less. Derate per pressure drop curves for higher viscosites.
[2] Limited by meter seal material, transmitter model, orientation and ambient temp. See manual. Consult factory.
[3] Some materials may have different filter requirements. Consult factory
[4] Typical. See flow meter/transmitter calibration sheet for actual K-factor and accuracy data.

Dos and Don'ts

DO:	DON'T:
• Install a bypass line around the meter • Clean the filter on a regular basis • Purge air from the meter before operating your system (Flowing near the meters maximum flow rate for a given viscosity will purge air bubbles. Tilting, tapping or shaking the meter at lower flow rates will also dislodge entrapped air)	• Run water or aqueous solutions through the meter (except the 234 Series of meters) • Put steam or compressed air through the meter. • Disassemble the meter • Apply excessive differential pressure across the meter • Exceed the maximum flow rates or pressure ratings for your meter • Let materials solidify in the meter • Try to pump through the meter if it contains frozen material. Re-melt the material completely before trying to pump through the flow meter.

Transmitter Specifications - Analog

Supply Voltage	12 Vdc (Models 29X-XXX-100) 24 Vdc (Models 29X-XXX-000)
Supply Current Short Circuit Current	90 mA max@ 12 Vdc, 45 mA max@ 24 Vdc 21 mA
[1] Output Update Rate Resolution	1 ms Adjustable without recalibration to any range of ± 10 Vdc
	Model 29X-3XX-XXX or ± 20 mA Model 29X-2XX-XXX
Ambient Temperature Range	Transmitter (Storage)-40ºC to 85ºC (-40ºF to 185ºF) [2] Transmitter (Operation)-40ºC to 80ºC (-40ºF to 175ºF)
Maximum Temperature, Process Fluid For explosion proof models see: http://www.maxmachinery.com/content/explosion-proof-installation-instructions (20ºC Ambient, 5V supply)	Standard Model 90ºC (195ºF) - Models 295 & 296 High Temp Model - Model 296 Ultra-High Temp Model 225ºC (435ºF) - Models 295 & 296
Anti-dither Range	Software selectable from 1-100% of 1 revolution. 50% of a meter revolution - unidirectional 2% bidirectional are typical default settings
Signal Filtering	Software selectable from 1 ms to 64 sec. time constant

[1] Full step change is subject to signal damping

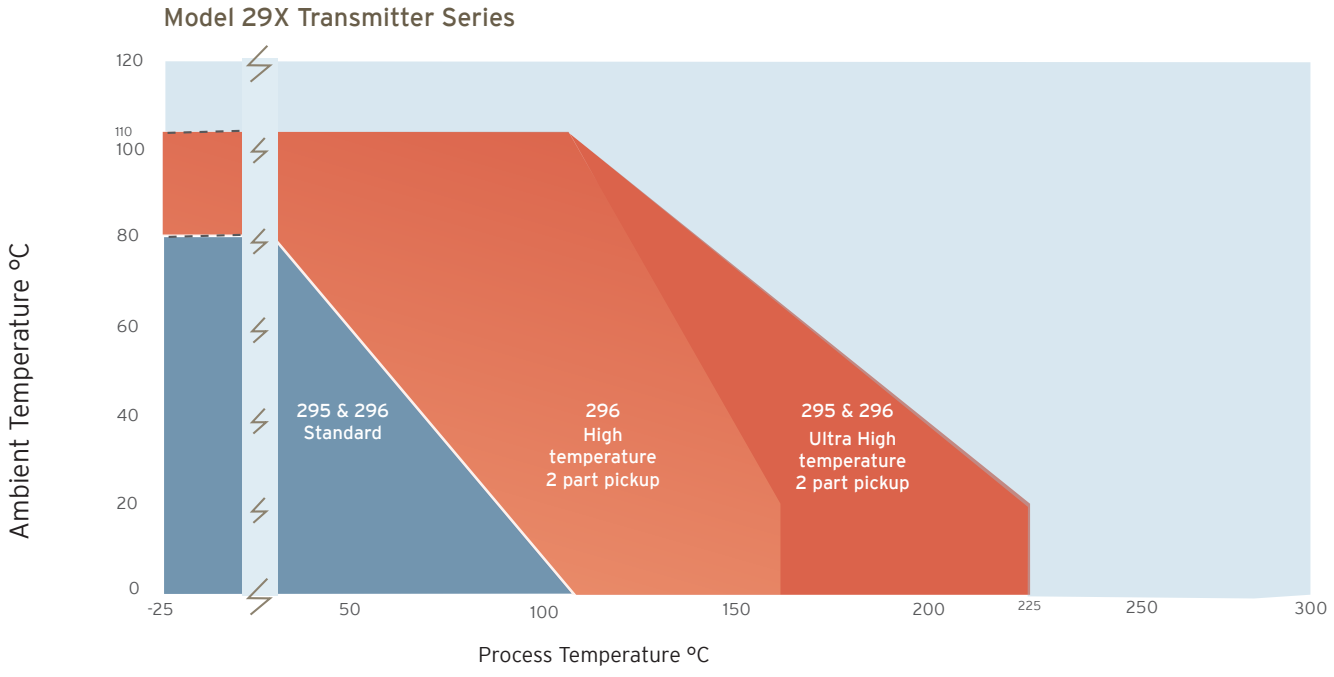
[2] Temperature of metered fluid will affect transmitter temperature, see graph below

Transmitter Specifications - Frequency (Pulse)

Supply Voltage Supply Current	5-26 Vdc 25-30 mA typical	
Output (5.0 Volt Supply) (TTL and CMOS compatible)	No Load 2.5K Load to Common 2.5K Load to +5 Volts	0.00 / 4.80 Volts 0.00 / 4.60 Volts 0.25 / 4.80 Volts
Short Circuit Current	45 mA	
Output Impedance	100 Ω	
Rise/Fall Time	0.2 µSec	
[1] Output Update Rate	1 ms	
Min/Max Frequency	0-60 kHz	
Resolution	1 - 1000 pulses/rev, Single Phase 1 - 500 pulses/rev/phase, Quadrature	
Ambient Temperature Range	Transmitter (Storage)-40ºC to 85ºC (-40ºF to 185ºF) [2] Transmitter (Operation) -40ºC to 80ºC (-40ºF to 175ºF)	
Maximum Temperature, Process Fluid For explosion proof models see: http://www.maxmachinery.com/content/explosion-proof-installation-instructions (20ºC Ambient, 5V supply)	29X-X0X-XXX Standard Model 90ºC (195ºF) 29X-X5X-XXX High Temp Model – 2 part model 225ºC (435ºF)	
Anti-dither Range	Software selectable from 1-100% of 1 revolution. 50% of a meter revolution - unidirectional 2% bidirectional are typical default settings	
Signal Filtering	Software selectable from 1ms to 250ms time constant	

[1] Full step change is subject to signal damping
[2] Temperature of metered fluid will affect transmitter temperature, see graph on previous page

Temperature Range Specification (Analog & Freq.)



Installation

For optimum performance, install the flow meter on the discharge side of the pump, in one of the configurations shown on page 9.

The following items and conditions should be considered:

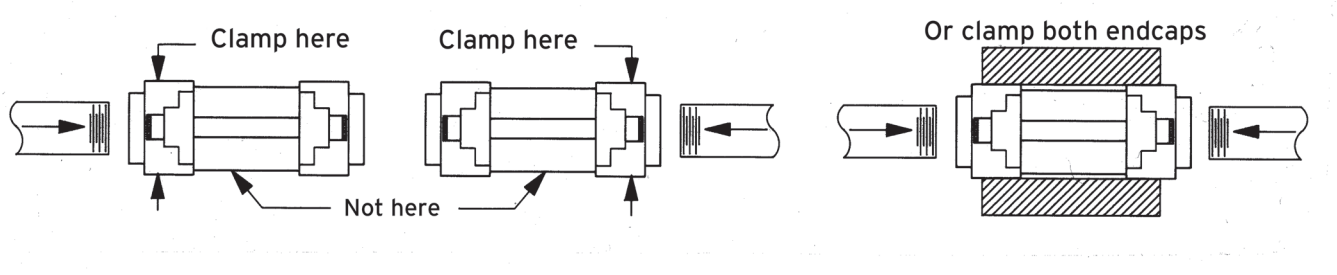
Location: Install the flow meter in a clean, dry area if possible. Avoid areas with high vibration levels.

Line and Bypass Valves: These valves allow filter cleaning or flow meter removal without completely shutting the system down and draining the lines. They are important for system start up under conditions which could damage the meter, such as: air in the lines, solid materials (at room temperature), high temperature materials, or initial line surges.

Filtration: Any dirt present in the system can jam or damage the meter. A 150 micron filter is generally recommended, although materials with very high viscosities may require a coarser filter. For bidirectional flow applications, use a filter on each side of the flow meter. Materials with fibrous or non abrasive particulate matter may have to be run without filters. Follow the recommendation of your Max Sales Engineer or consult Technical Service.

Clean Plumbing: Before installing the flow meter, clean the inside of the pipe line with compressed air or steam (especially when using new pipe). Don't use water, steam, or compressed air on the meter itself! Remove any protective covering from the flanges (if applicable).

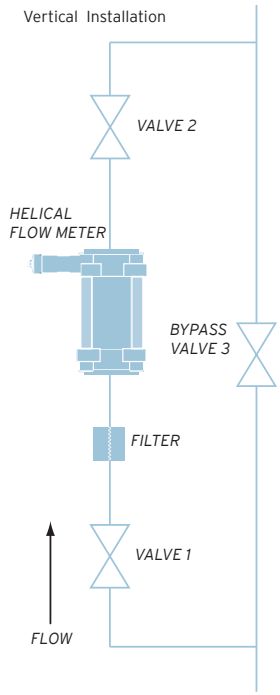
Pipe Threading: When installing pipe to the flow meter, support the nearest end cap or both end caps (as in a vise). Don't clamp the flow meter body. This avoids possible misalignment of flow meter components when the pipe is screwed tight. Check for proper flow meter operation by rotating the timing gear through the transmitter mounting hole. It should move freely and without noise.

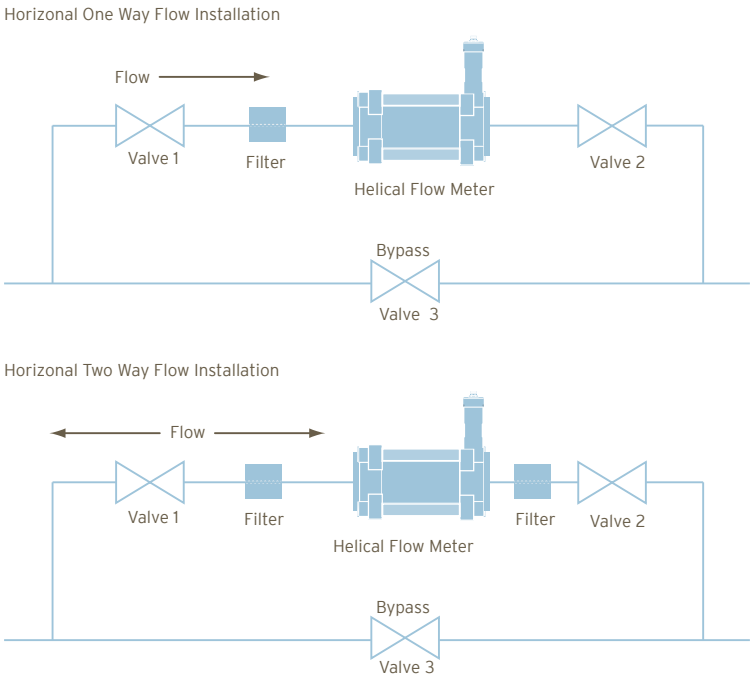


High Temperatures: Use the "Vertical Installation" drawing. This minimizes heat transfer by convection from the flow meter to the transmitter. The transmitter is the most heat sensitive element in the system and the transmitter manual should be consulted for specific limits. Optional heating fluid ports are available for the flow meter to keep it at operating temperature during standby conditions. For substances that are solid at room temperature, these ports are generally required to keep the material molten and flowing through the meter.

ANSI Flanges: Using the 241, or 242 meters at pressures greater than 500 psi will also require flanges. See the specifications and bolt torque table on page 9. Max has bolt kits available for flange installations.

Piping Diagrams





ANSI Flange Stud Torque

240 Series ANSI Flange Stud Torque Requirements. This table shows the minimum torque required for a 2:1 tightening factor at the indicated pressures using zinc plated studs and nuts. These values were calculated using studs with a yield strength of Sy = 75,000 psi.

Meter (Flange)	Studs		Torque For Line Pressure ft-lb (N-m) See notes below					Absolute Max Torque ft-lb (N-m)	Stress at Max Torque (psi)*
	Qty	Size	500	1000	1500	2500	3500		
241 (600# Flange)	4	3/4-10	24 (33)	49 (67)	73 (99)			200 (271)	47,904
241 (2500# Flange)	4	1-1/8-7	37 (50)	73 (99)	110 (149)	183 (248)	256 (247)	681 (924)	47,789
242 (600# Flange)	8	3/4-10	24 (33)	47 (64)	71 (96)			200 (271)	47,904
242 (1500# Flange)	8	1-8	31 (42)	63 (86)	94 (128)	157 (213)	219 (297)	483 (656)	47,822

Notes:

Using the 241, or 242 meters at pressures greater than 500 psi *will require flanges*. Max has bolt kits available for flange installations.
For unplated non-lubricated nuts and studs, multiply the above torque by 1.5.
For lubricated nuts and studs, multiply the above torque by 0.9.
For cadmium plated nuts and studs, multiply the above torque by 0.8.
*Stress in bolt calculated for thread root diameter.

Operation

Determine that the following parameters of your flow metering system are within specifications for the specific 240 Series Meter being used:

Maximum System Pressure	(Specifications)
Differential Pressure across meter	(Pressure Drop Curves)
Maximum Flow Rate	(Pressure Drop Curves)
Metered Fluid Temperature	(Sales specification, transmitter manual)

If the metered fluid is greater than 80°F (28°C) over ambient, see the "High Temperature Start Up" section.

With valves one and two closed, slowly open valve three (bypass) to clear the lines of foreign particles and air. Slowly open the inlet valve (# I). Slowly open the outlet valve (# 2). Completely close the bypass valve.

No routine maintenance, cleaning, or lubrication of the flow meter is required. A routine filter cleaning schedule should be established. The system should be shut down if abnormal noises occur or if unusual differential pressures across the meter are encountered.

High Temperature Start Up: For fluids above 150°F (82°C) based on 70°F ambient, a special procedure is required to prevent thermal shock and permanent damage to the flow meter.

The warm up time is determined by the equation below:

$$\text{TIME (minutes)} = \frac{\text{connector size (in inches) x (operating temperature (F) -125)}}{10}$$

—OR—

$$\text{TIME (minutes)} = \frac{\text{connector size (in inches) x (operating temperature (C) -52)}}{10}$$

Valves one and two must be closed. Open the bypass valve (# 3) in gradual steps until the bypass piping is stabilized at operating temperature. Open valve one slightly and allow the temperature to stabilize around the flow meter. Valve one can then be opened completely. Open valve two slightly. The flow meter may make unusual noises or bind at this point. Leave the valve at this setting until normal meter operation occurs, at which point valve two can be gradually opened all the way. Slowly close the bypass valve (# 3).

 © Copyright 2015

Installation

Removal note: The transmitter does not need to be removed from the flow meter for any field servicing or adjustments. Normally, the flow meter and transmitter are shipped back to the factory for calibration or service as a unit. If the transmitter needs to be removed from the flow meter for installation, be sure to retighten the transmitter snugly in order to ensure proper sensor alignment.

Mechanical Installation
1. The transmitter is attached to the flow meter's threaded magnet shield. Hand tighten only. (~ 3 ft-lb)
2. The transmitter lid has four thread paths. To realign the cable, remove the lid and rotate up to 180° and retighten using an alternate starting point. Tighten to compress the O-ring seal.

Removal
1. Remove electrical connections
2. Unscrew transmitter, using a wrench if necessary.

WARNING

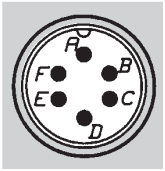
Installation and removal should only be facilitated by trained personnel
Verify transmitter output type (ANALOG or FREQUENCY) before wiring, inappropriate wiring could result in damaging the circuit.

Moisture Seal Protection
On all models, the housing is designed as a liquid and vapor-tight enclosure. There are O—ring seals at the lid and possibly also the base of the housing — these need to be fully seated. A properly sealed transmitter will prevent the formation of damaging moisture inside the housing.
Turck connector Model: The connector is sealed to the lid at the factory and is ready for use.
NPT Model: To ensure a moisture-tight seal, apply appropriate sealant to the threads at installation.

Electrical Installation: Wiring – Helical 289

	NPT Models Circuit Board Terminal #	6-Pin Connector Mating Cable Wire Color	Pin #
Case Ground	1	Green	A
Common	2	Black	B
Power (+5-24 VDC)	3	Red	C
Pulse Output	4	White	D

Amphenol Connector

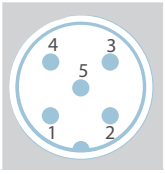


Electrical Installation: Wiring – All other transmitters

The electrical connector versions are pre-wired inside the transmitter and ready to accept a mating cable (available from the factory).

Frequency Single Phase	Frequency 2 phase, Quadrature	Analog**	Mating Cable Wire Color	Turck Pin # (Male)
Case Ground	Case Ground	Case Ground	Blue	3
Common	Common	Common	Black	4
Power 5-26 Vdc	Power 5-26 Vdc	Power *	Brown	1
Pulse Output	Output Phase A	Signal Output (-)**	White	2
N/A	Output Phase B	Signal Output (+)	Grey	5

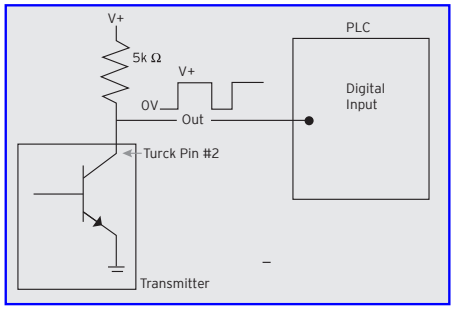
Turck Connector (Female)



Note: There are no selections or adjustments to be made on the circuit board. The only method of altering the setup parameters is through the Serial Interface Program.
* Analog transmitters with part numbers 29X-XXX-000 or ending in A/1 or C/1 are 24Vdc power. Part numbers 29X-XXX-100 or ending in B/1 or D/1 are 12Vdc power.
** To minimize noise, analog output transmitters are fully isolated. If your system does not ground the negative signal input you should install a 10k pull down resistor between Common and Signal Output (-). This will avoid the risk of ground shifts which could drive the signal out of range.

Current Sinking Wiring (Part # 295-600-000 and versions ending with S/1)

A current sinking device is essentially a switch where the transmitter's output opens and closes a switch. A positive DC voltage must be applied to the transmitter's output pin. When the output is triggered, this voltage will be grounded to zero volts by the transmitter. Use a 5k ohm resistor to limit current if your system does not have any other means to limit the current into the transmitter.



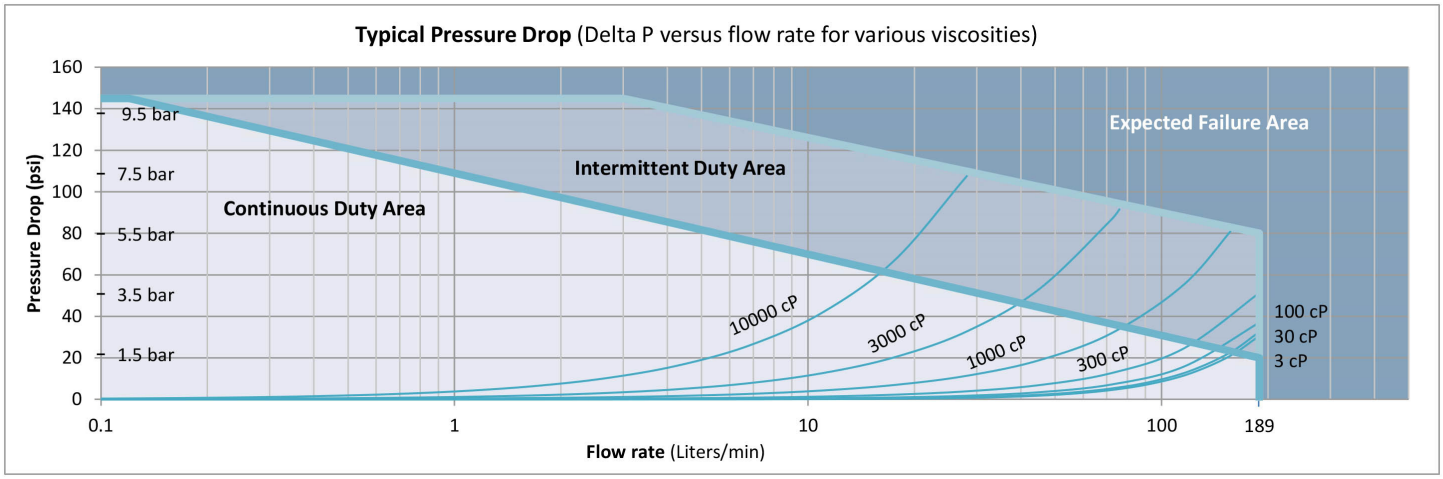
 © Copyright 2015

Troubleshooting

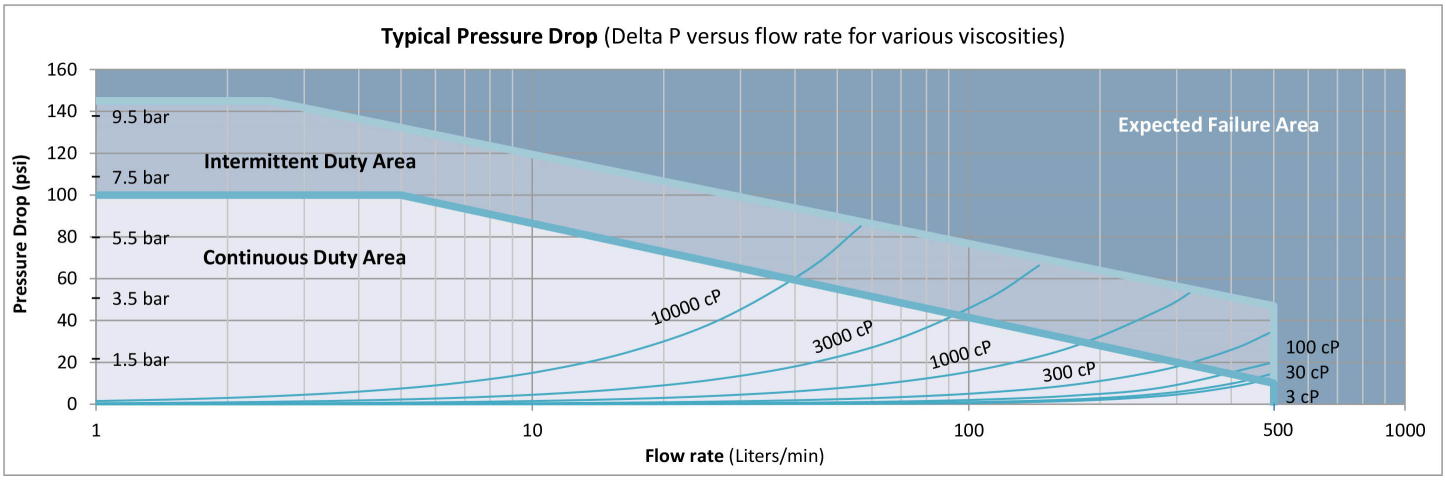
Trouble	Corrective Action
No Flow through meter or high pressure drop across meter	
Solidified material blocking rotation	Heat meter to melt material.
Debris blocking rotation	Remove meter from line. Flush with an organic solvent or petrochemical. Try to work debris out of the meter.
Meter broken	If you find damaged parts in the meter, return the meter to the factory for repair.
Fluid is passing through the meter, but there is no indication of flow	
Improper hook-up of transmitter	Verify that DC power is present at the PCA. Use a multi-meter to measure the transmitter output independent of the display or PLC. Inspect cabling.
Indicated flow does not agree with expected readings	
Air in the line	Air bubbles displace the meter just as a liquid would. If you are over-reporting, verify that there is no air in the lines.
Indicator not calibrated properly	Verify the K-Factor for the meter in use and compare this value to the setting used in the display.
Excessive reverse flow in system	Max transmitters have anti-dither functions which can buffer up to 1 revolution of reverse flow. An incorrect flow total can be reported if the pumping causes a flow and ebb of greater than 1 meter revolution.

© Copyright 2015

241 Helical Flow Meter



242 Helical Flow Meter



Contact for Repairs & Calibration Services

Your Max 240 Series Meter should be repaired at the factory or under the direct supervision of the Max Technical Service Department. Unauthorized repair work may damage the meter and will void the product warranty. Please make note of model and serial numbers on the flow meter before calling the factory. A return goods authorization number (RMA) will be issued if the flow meter has to be sent back for repair.

Max Machinery, Inc.
33A Healdsburg Ave
Healdsburg, CA 95448

Phone: 707-433-2662
Fax: 707-433-1818
www.maxmachinery.com

Limited Warranty

The Seller warrants all equipment manufactured by it to be free from defects in materials and workmanship in normal service for a period of twelve (12) months from the date of shipment. When given prompt notice by the Purchaser, the Seller shall, in complete fulfillment of its liabilities under this warranty, correct by repair or replacement any such defect without charge F.O.B. the Seller's factory, with the following stipulations:

1. Product is not to be returned to Seller without first obtaining a product-evaluation quote number from our Customer Service Department at (707) 433-2662.

2. Seller assumes no liability for charges incurred for repairing, removal or replacement, or for repairs made outside of its factory.

3. Seller reserves the right to inspect products claimed defective under warranty and is the final authority on the validity of the warranty claim. (Actions that void the warranty include, but are not limited to, disassembly of the meter, failure to install recommended filtration or passing incompatible liquids through the meter.)

IT IS EXPRESSLY AGREED THAT THIS WARRANTY OR ANY OTHER WARRANTY STATED OR REFERRED TO ON THE SALES ORDER DOCUMENT IS EXCLUSIVE AND IN LIEU OF ANY OTHER WARRANTY OF MERCHANTABILITY, FITNESS OF PURPOSE, OR ANY OTHER WARRANTY OF QUALITY, EXPRESS OR IMPLIED.